Generation IV Nuclear Energy Systems Initiative

Office of Nuclear Energy, Science and Technology
U. S. Department of Energy

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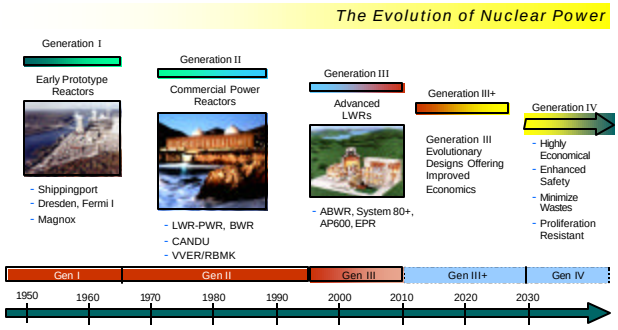
What is Generation IV?

Today there are 441 nuclear power reactors in operation in 31 countries around the world. Generating electricity for nearly 1 billion people, they account for approximately 17 percent of worldwide electricity generation and provide half or more of the electricity in a number of industrialized countries. Another 32 are presently under construction overseas. Nuclear power has an excellent operating record and generates electricity in a reliable, environmentally safe, and affordable manner without emitting noxious gases into the atmosphere.



Concerns over energy resource availability, climate change, air quality, and energy security suggest an important role for nuclear power in future energy supplies. While the current Generation II and III nuclear power plant designs provide an economically and publicly acceptable electricity supply in many markets, further advances in nuclear energy system design can broaden the opportunities for the use of nuclear energy. To explore these opportunities, the U.S. Department of Energy's Office of Nuclear Energy, Science and Technology has engaged governments, industry, and the research community worldwide in a wide-ranging discussion on the development of next-generation nuclear energy systems known as **"**Generation IV**"**.

Generation IV International Forum (GIF)

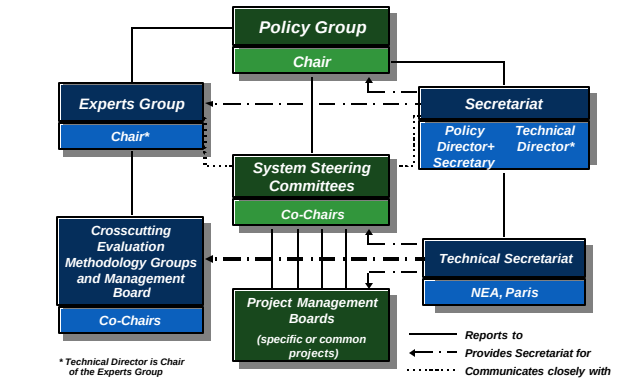
The objective of the U.S. Generation IV Nuclear Energy Systems Initiative is to develop and demonstrate advanced nuclear energy systems that meet future needs for safe, sustainable, environmentally responsible, economical, proliferation-resistant and physically secure energy. Under U.S. DOE leadership, this initiative has led a group of ten countries (Argentina, Brazil, Canada, France, Japan, the Republic of Korea, the Republic of South Africa, Switzerland, the United Kingdom, and the United States) and Euratom to jointly plan the fulfillment of this objective. In 2002, the Generation IV International Forum (GIF) was chartered, establishing a Policy Group as the highest policy-making organ, an Experts Group as the technical advisory organ, and a Secretariat to administer and coordinate GIF activities. In 2003, the GIF, together with the Department's Nuclear Energy Research Advisory Committee, issued *A Technology Roadmap for Generation IV Nuclear Energy Systems*. Based on the *Roadmap*, GIF countries are jointly preparing collaborative R&D programs to develop and demonstrate candidate concepts.

Technology Goals

Generation IV nuclear energy systems will:

- Provide sustainable energy generation that meets clean air objectives and promotes long-term availability of systems and effective fuel utilization for worldwide energy production.
- Minimize and manage their nuclear waste and notably reduce the long term stewardship burden in the future, thereby improving protection for the public health and the environment.
- Increase the assurance that they are a very unattractive and least desirable route for diversion or theft of weapons-usable materials.
- Excel in safety and reliability.
- Have a very low likelihood and degree of reactor core damage.
- Eliminate the need for offsite emergency response.
- Have a clear life-cycle cost advantage over other energy sources.
- Have a level of financial risk comparable to other energy projects.

GIF Governance Structure



Generation IV Technology Roadmap

A Technology Roadmap for Generation IV Nuclear Energy Systems documents a comprehensive evaluation of nuclear energy concepts and selects the most promising ones as candidates for next-generation nuclear energy system concepts. For these concepts, detailed R&D plans were developed for establishing technical and commercial viability, demonstration and, potentially, commercialization. More than 100 experts from twelve countries and international

organizations collaborated to complete the *Roadmap* over a period of two years. The *Roadmap* was submitted to Congress, followed by the *U.S. Generation IV Implementation Strategy*, which provides the strategy for implementing the Generation IV program in the United States.

http://gen-iv.ne.doe.gov

International Collaboration on Generation IV Systems

The Department seeks to leverage its research investments in Generation IV concepts with research funding from interested members of the GIF. In FY 2004, the GIF countries, including the United States, began formulating joint R&D plans based on the *Roadmap*. The GIF countries began the formulation of multilateral agreements to enable the planned R&D collaboration and established a governance structure involving System Steering Committees and Project Management Boards. The United States is currently working closely with France, Japan, Korea, South Africa, and the United Kingdom through the GIF to establish a multinational research program to develop the technologies needed to support the design and construction of next-generation, very-high-temperature, gas-cooled reactors. In the meantime, R&D was initiated on several Generation IV reactor concepts under existing bilateral I-NERI agreements. These concepts include the Gas-Cooled and Lead-Cooled Fast Reactor Systems, the Supercritical-Water-Cooled Reactor, and the Very-High-Temperature Reactor (VHTR).

U.S. Generation IV Priorities

While the Department is supporting research on several reactor concepts, priority is being given to a system that matches VHTR technology with advanced hydrogen and electricity generation capabilities -- the Next Generation Nuclear Plant (NGNP). The special emphasis on the NGNP reflects its potential for economically and safely producing electricity and hydrogen without emitting greenhouse gasses. Within the Department's FY 2005 budget request of $30.5 million for the Generation IV program, $19.3 million is budgeted for the NGNP effort. FY 2005 NGNP activities will be focused primarily on research and development activities associated with fuels and structural materials for high-temperature, high-radiation service conditions and continuing concept design activities initiated in FY 2004.

The Department is exploring the possibility of moving forward with a new reactor development project to take the Next Generation Nuclear Plant and associated hydrogen production technologies from concept to technology demonstration. A range of options with regard to such a technology is being explored, which options will be narrowed as the research effort proceeds.

Research and development for the other Generation IV systems will focus on establishing technical and economic viability, and the resulting core and fuel designs and materials requirements.

FY 2003 Accomplishments:

- Submitted *A Technology Roadmap for Generation IV Nuclear Energy Systems* to Congress.
- Established NGNP functions and requirements.
- Initiated R&D on six Generation IV concepts.
- Developed the NGNP reference point design.
- Submitted *U.S. Generation IV Implementation Strategy* to Congress.

FY 2004 Planned Accomplishments:

- Complete the independent technical review of NGNP technologies.
- Award contract for NGNP preconceptual design services.
- Develop NGNP fuel particles and compacts including quality control approaches.
- Complete plans for high-temperature materials irradiation testing.
- Initiate university R&D activities directed toward Generation IV reactor development.

FY 2005 Planned Accomplishments:

- Complete NGNP preconceptual design.
- Initiate radiation testing of NGNP fuel.
- Initiate NGNP materials testing.

Program Budget
Generation IV
($ in Millions)

FY 2003 Adjusted Appropriation	FY 2004 Adjusted Appropriation	FY 2005 Request
$11.5	$23.2	$30.5